GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2020-2021

Material Physics (C001369)

Due to Covid 19, the education and evaluation methods may vary from the information displayed in the schedules and course details. Any changes will be communicated on Ufora.

Course size (nominal values; actual values may depend on programme)

Credits 6.0 Study time 180 h Contact hrs 52.5 h

Course offerings and teaching methods in academic year 2020-2021

A (semester 1)	Dutch	Gent	seminar: practical PC room classes	2.5 h
			lecture	30.0 h
			project	1.25 h
			seminar: coached exercises	13.75 h
			demonstration	2.5 h
			excursion	2.5 h
			online lecture	0.0 h
			online seminar: coached exercises	0.0 h
			online seminar: practical PC room classes	0.0 h

Lecturers in academic year 2020-2021

Callens, Freddy	WE04	lecturer-in-charge
Depla, Diederik	WE04	co-lecturer

Offered in the following programmes in 2020-2021	crdts	offering
Bachelor of Science in Physics and Astronomy	6	A

Teaching languages

Dutch

Keywords

Crystallography, anisotropy, x-ray diffraction, macroscopic physical properties.

Position of the course

Study of the structural properties of solid materials. Give the student insight in the close relationship between the atomic structure and symmetry of solid materials and their macroscopic properties (mechanical, electrical, magnetic, optical). Introduction to the courses in solid state physics. Introduction to experimental scientific materials research.

Contents

- Ch1: Geometrical crystallography: Steno’s law, Haüy’s law, and the Miller indices
- Ch2: The internal structure of crystals: unit cell, crystal lattice, projection of crystal structures
- Ch3: Crystal symmetry: point groups, plane groups and space groups.
- Ch4: X-ray diffraction: von Laue conditions, Bragg’s law, systematic absences, X-ray production, measuring a diffraction pattern
- Ch5: Crystal structures: dense packing, ionic, covalent and metallic structures
- Ch6: Lattice defects: Point defects: vacancies and interstitials; Dislocations; The surface; Surface analytical techniques
- Ch7: Electrical properties: Insulators – semiconductors – metals; Anisotropy; Ferro-electrics and piëzo-electrics
- Ch8: Optical properties: Complex dielectric function: refractive index and extinction coefficient; Optical dispersion; Optical anisotropy and double refraction; Optical properties of insulators, semiconductors and metals

- Ch9: Magnetic properties: Diamagnetism, paramagnetism, Magnetic domains, Ferro-, antiferro- and ferrimagnetism
- Ch10: Mechanical properties: Elastic and plastic deformation, Influence of symmetry on stress and strain, Thermal expansion

Initial competences

The course implies knowledge of basic physics: mechanics, electricity and magnetism and optics. No other specific prior knowledge is assumed.

Final competences

1 Have insight in the symmetry properties of solid materials and the relation to their macroscopical physical properties.
2 Master the important concepts, needed for the courses in solid state physics: Bravais lattice, reciprocal lattice, ...
3 Have insight in the relevant historical developments in materials research.
4 Be able to select experimental analytical techniques for the determination of the structure and composition of materials.
5 Handle classical and modern scientific sources in a critical way.
6 Report orally and written on projects related to material physics.
7 Have attention for possible applications and business aspects of material physics.

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Guided self-study, demonstration, excursion, lecture, project, seminar: coached exercises, seminar: practical PC room classes, online demonstration, online lecture, online seminar: coached exercises, online seminar: practical PC room classes

Extra information on the teaching methods

Because of COVID19 changes can be made if necessary.
Theory: oral presentations with multimedia-support (Ufora)
Exercises:
- Problems, related to the theory, under support
- Personal task: crystal growth from a solution
- Demonstration of research equipment
- Company visit

Learning materials and price

A syllabus is available at € 10.00
Handouts of presentations, used during the course, are made available in electronic form.

References

- C. Hammond, The basics of crystallography and diffraction, 3rd ed., Oxford University Press, New York (2009)
- J.F. Nye, Physical properties of crystals, Oxford University Press (1985)
- W.D. Callister, Materials science and engineering: an introduction, 8th ed., Wiley (2010)
- V. K. Pecharsky, P. Y. Zavalij, Fundamentals of powder diffraction and structural characterization of materials, 2nd ed., Springer (2008)

Course content-related study coaching

Website with additional material and references available. Ample opportunity for asking questions, both personally and by electronic mail.

Evaluation methods

end-of-term evaluation

Examination methods in case of periodic evaluation during the first examination period

Written examination with open questions, assignment

Examination methods in case of periodic evaluation during the second examination period

Written examination with open questions

Examination methods in case of permanent evaluation

Possibilities of retake in case of permanent evaluation

not applicable

Extra information on the examination methods

Theory and exercises: written exam (closed book) with open questions. Evaluation of home-grown crystal.

Calculation of the examination mark

Evaluation of home-grown crystal: 10%; Exam: 90%.